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# *Interactive comment on* "Evaluation and comparison of MAIAC, DT and DB aerosol products over China" *by* Ning Liu et al.

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We would like to take this opportunity to thank the editor and the Reviewer 1 for their positive review and constructive suggestions. We have revised the manuscript based on the suggestions. All the correction in this revision process are marked by red color. Given below is a summary of the responses and revisions.

Reviewer 1: General comments: Validation of the aerosol products derived from the satellite observation is an important issue. This study gives a compressive assessment for the AOD products based three aerosol retrieval algorithms in MODIS sensor using ground-truth measurements from Aerosol Robotic Network (AERONET) sites over China. This manuscript is logically organized, the analysis methods are technically



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sound but not novel, and the results are interesting albeit some points not adequately illustrated. I have some comments on interpretation of the major results. As such, I recommend its publication pending the following concerns satisfactorily addressed.

Specific comments: 1. Page 3, Line5-10: the description of 'shortwave infrared band, e.g. 212 nm' is wrong. The authors mistook the unit.

Response: Thanks for your carefully review on our manuscript. We have corrected the all the wrong description '212 nm' into '2119 nm' in the revised manuscript (e.g. page 3, line 12; page 4, line 18).

2. Page 4, Line26-28: how to get the AOD at 550 nm using Ångström exponent in the two neighboring bands at 500 nm and 675 nm, which should be shown. It is a key to confirm the reliability of AERONET data as a reference to evaluate the MODIS products.

Response: We have added the corresponding Ångström exponent formula in the page 5, line 10-13 to show how we calculate the AOD value at 550nm using measurements from two neighboring bands at 500 nm and 675 nm in the revised version.

3. Page 4, line 25-31, these are about the AERONET data introduction, what's more, these are about why you choose the AERONET data as a reference to evaluate the MODIS products, which are omitted, including the reliability of AERONET measurements in China (e.g. Liu et al., Aerosol optical properties and radiative effect determined from sky-radiometer over Loess Plateau of Northwest China. 2011, ACP; Bi et al., Dust aerosol characteristics and shortwave radiative impact at a Gobi Desert of Northwest China during the spring of 2012. 2014, J. Meteo. Soc. Jp; Che et al., Column aerosol optical properties and aerosol radiative forcing during a serious haze-fog month over North China Plain in 2013 based on ground-based sunphotometer measurements. 2014, ACP).

Response: Thanks for your suggestion on this point. Sentences addressing the reli-





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ability of AERONET measurements and relative references are added as suggested. And this can be found in the page 4, line 32 to page 5, line 1-5.

4. The authors introduced the statistical approach, however, what's meaning of 'QA filter'? furthermore, what's meanings of 'before QA filter' and 'after QA filter'? What's the relation between the statistical approach with QA filter? These should be added in statistical approach.

Response: We are sorry for the ambiguous description on the QA filter. Actually, snow, cloud, land cover type will increase the retrieval uncertainty of satellite based AOD. In order to help users to select the satellite based AODs with best quality, DT/DB/MAIAC AOD products provide a QA flag to indicate their retrieval uncertainties. QA=3 means good quality for DT algorithm, QA=2,3 means good quality for DB algorithm, and the 8 11 byte (bits "0000") of "AOD QA" SDS datasets in MAIAC products means good quality. In this study, we evaluate the accuracy improvement and the spatiotemporal completeness reduction after QA fiter. Descriptions about QA fiter were added in page 3, line 3-4,23-24; page 4, line 22-24; page 4, line 8; page 4, line 26. And we also stated "All the statistical indicators are calculated for three products before and after QA filter" in the end of section 3.3 of statistical approach.

5. According to the information of AERONET sites, as listed in Table 2, the time durations of data are significantly different among the sites, and the MODIS products are from 2000-2017. So, the problem is how to exclude the limitation of different temporal scales? Additionally, a table on the summary of comparison samples at each AERONET station with three MODIS products is needed.

Response: As pointed, the time durations of AERONET sites are significantly different. However, after adding the number of matchup pairs for three aerosol products in the Table 1. We found the distribution in each site for three aerosol products are very similar, so the matchup pairs for three aerosol products in the same AERONET site are from the same period. Thus, the validation results are still comparable between three

aerosol products. Meanwhile, it has to be acknowledged that the biggest influence caused by different time scales may be the yearly validation results in Figure 11 as the validation results in each year are calculated from different AERONET sites. However, if we only adopt the data from sites which the monitoring period cover the whole study time (i.e. 2000-2017), the eligible AERONET sites would be very less. So in this validation process, we still adopt all sites' data as previous convention. But in this process, we carefully checked any singular results presented in Figure 11 to judge whether the singular result are caused by different time scales of AERONET site, three retrieval algorithms or the MODIS sensors from Terra. All the analysis mentioned above are added in the page 27, line 3-8, line 10-13, line 18-22.

6. In Figure 3-5, the seasonal variation of the land cover has not been considered, the land type is determined one type in entire year, as listed Table 2. However, the land cover varies in different seasons. Thus, there may be inaccuracy to evaluate the products under different land type. So, I suggest you can consider the seasonal land type in monthly and seasonal evaluation of MODIS products.

Response: The validation in seasonal variation of land cover type is needed, however, the lacking seasonal land cover data is the biggest problem to do this. What's more, most common used land cover products are most yearly scale due to the less changes in short time period, including land cover data used in this study, MODIS land cover products (MCD12), etc. Instead, we consider to evaluate the seasonal performance of three satellite aerosol retrieval algorithms under the same land cover type. The corresponding results are shown in Table 5. And the analysis on Table 5 are presented in page 18, line 3-11.

7. Figure 12 shows that the QA filter indicates little influence on the MAIAC product itself, similar to DT product. Therefore, what's the importance or role of the QA filter?

Response: Although the QA filter has a little influence in the spatial pattern of averaged AOD during 2000 and 2017, the accuracy of three MODIS products after QA filter is all

improved based on the previous validated results. Thus, the QA flag is still needed to tell users to select AOD products with the best quality.

8. I suggest the authors can combine Figure 13 and 14 into one graph.

Response: Corrected.

9. The time period should be described for Figure 12-14.

Response: Corrected.

10. In the abstract and conclusion, the authors need tell us clearly which product is better to use under which kind of land cover type instead of specifics of bias, correlation coefficient and so on. I suggest the authors rephrase the abstract more general.

Response: Thanks for your suggestion, we have modified the abstract and conclusion. In these two sections, we purified major conclusion from overall validation, land cover type dependency analysis, view geometry dependency analysis, spatiotemporal retrieval accuracy analysis, spatial pattern variation difference analysis and spatiotemporal completeness analysis.

Attachment is the revised manuscript.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-1339/acp-2018-1339-AC1-supplement.pdf

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